Bio-Inspired Autonomous Communications Systems with Anomaly Detection Monitoring, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

We propose to develop and demonstrate BioComm, a bio-inspired autonomous communications system (ACS) aimed at dynamically reconfiguring and redeploying autonomous communication assets in accordance with both mission objectives and communication demands simultaneously. BioComm is embedded with ADaM (Anomaly Detection and Monitorin) capability, which enables human supervisors or operators to exploit, benefit from, and interact with BioComm systems with high confidence by alerting the operators of multiple, heterogeneous ACSs on anomalous system behaviors without requiring a deep understanding of the functions in the underlying systems. The proposed solution (BioComm-ADaM) is based on the unique combination of: (i) Digital Hormone Model augmented with Criticality-Sensitive Control with the goal of achieving rapid self-configuration and fully autonomous adaptive deployment, redeployment, and reconfiguration of NASA's autonomous communication assets under a broad range of mission scenarios; and (ii) Surprise-Based Learning capable of learning the expected or normal behavior of a wide range of autonomous systems, detect any behavioral anomalies or deviations from the norm, identify potential causes, recommend some feasible changes to a human supervisor, and execute the selected or recommended changes. The BioComm system adds a powerful new degree of freedom for self-adaptation, which is the "mobility" of autonomous communication assets based on their awareness of the "communication environment", thus allowing radios to adapt both their software parameters and physical locations or formations so as to best support space missions. Thus, BioComm will greatly expand the feasible dimensions of self-adaptation for communication parameters by further allowing the autonomous assets to "move" to "right" places when the autonomous adaptation of parameters alone is not sufficient in order to achieve much greater and powerful autonomous end-to-end communication capabilities.

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Table of Contents

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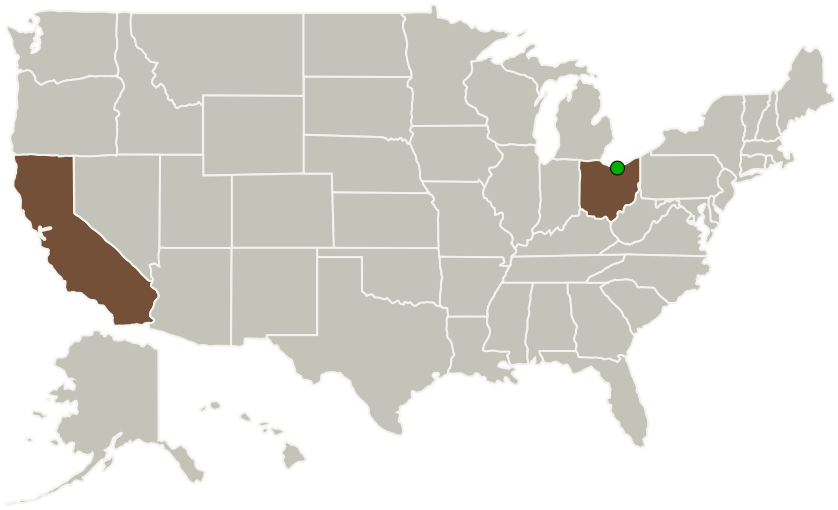
Completed Technology Project (2014 - 2014)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
EpiSys Science, Inc.	Lead Organization	Industry Small Disadvantaged Business (SDB), Women-Owned Small Business (WOSB)	Poway, California
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
University of Southern California Information Sciences Institute(USC-ISI)	Supporting Organization	Academia	Marina del Rey, California

Primary U.S. Work Locations	
California	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

EpiSys Science, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

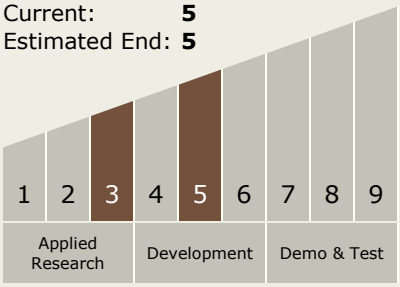
Carlos Torrez

Principal Investigator:

Bo K Ryu

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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Project Transitions

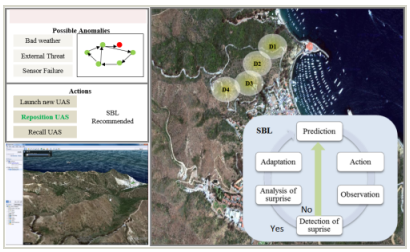
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137675)*

Images



Briefing Chart
Bio-Inspired Autonomous Communications Systems with Anomaly Detection Monitoring, Phase I
(https://techport.nasa.gov/image/134118)

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - TX05.5 Revolutionary Communications Technologies
    - TX05.5.1 Cognitive Networking

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System